Time Dependence on Transverse Amplitude in Linac

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- Time of flight in general depends on transverse amplitude
- Dependence is directly proportional to chromaticity
- Chromaticity is uncorrected in linac
- Time of flight deviation is approximately

$$-\frac{2\pi}{\Delta E} \ln\left(\frac{p_f}{p_i}\right) \boldsymbol{\xi} \cdot \boldsymbol{J}_n,$$

  - ◆ Initial and final momenta p_i and p_f, chromaticity $\boldsymbol{\xi}$ and energy gain ΔE per cell, normalized transverse action $\boldsymbol{J}_n$ in eV-s

- Synchrotron oscillations alleviate the problem somewhat
  - ◆ Don't occur in higher energy part of linac
- About 30° of phase slip in 500–1500 MeV linac

What to do

- Need to do tracking in linac to ascertain the effect
  - Tracking code needs to include **everything**: avoid approximations

- Could we add occasional chicanes with positive chromaticity?
  - Dynamic aperture or beam blowup

- Shorten linac, go into small RLA sooner

- RLA may see this issue also
  - Alleviated by synchrotron oscillations somewhat
    - ★ Turns into energy shift
  - Can we over-correct chromaticity in arcs?
    - ★ Geometric aberrations